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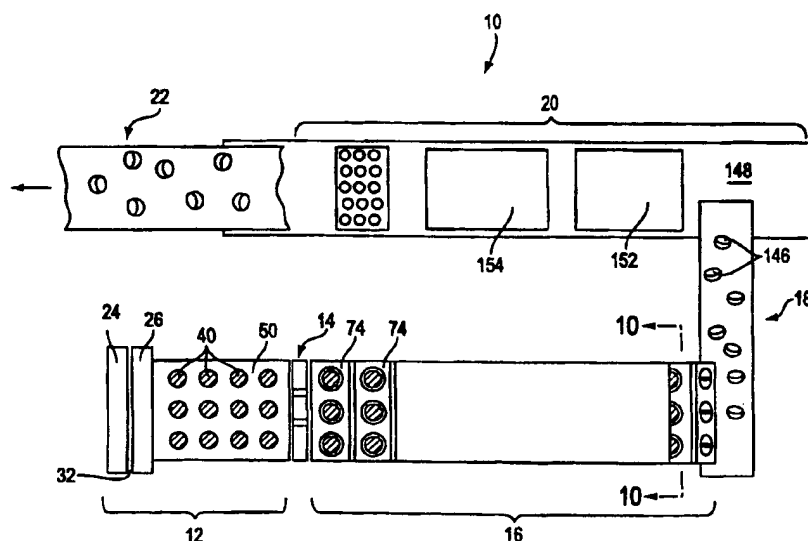
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(54) Title: METHOD AND APPARATUS FOR MAKING BOWL-SHAPED SNACK FOOD PRODUCTS



(57) Abstract

A method and apparatus for making bowl-shaped snack food products, e.g. tortilla chips. The method features placing chip preforms in open bowl-shaped cavities and partially frying the chip preforms by filling them with hot oil from above. Additionally, the preforms are partially fried from below by immersing the lower portions of the preforms in a vat of hot oil and transporting them through the hot oil. After cooking the preforms to a desired moisture content, at which point the preforms retain their bowl shapes outside of or independent of the mold cavities, the preforms are removed from the mold cavities and subsequently cooked to completion in a secondary frying operation. The invention also features an apparatus to carry out the method.

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METHOD AND APPARATUS FOR MAKING BOWL-SHAPED
SNACK FOOD PRODUCTS

BACKGROUND OF THE INVENTION

1. Technical Field

5 The invention relates generally to a method and apparatus for food production and, more specifically, to a method and apparatus for making fried, bowl- or other scoop-shaped snack food chips.

2. Description of the Background Art

10 In general, there are a number of food products which are shaped to help the product satisfy a particular function. For example, taco shells often are made by frying corn dough in a folded-over configuration to provide a U-shaped "trough" which is filled with the taco
15 ingredients. With respect to snack food products, consumers often prefer a bowl- or scoop-shaped chip (corn chip, tortilla chip, potato chip, etc.) when eating chips

with dip (salsa, bean dip, cheese dip, etc.) because the bowl- or scoop-shaped configuration gives the chip strength -- thereby preventing breakage of the chip while scooping dip -- and allows the consumer to scoop up a
5 larger, more satisfying portion of dip.

In the past, the methods and apparatus used to make such shaped products have been somewhat complex. In particular, they have tended to use closed molds in which the product is fixedly held while being cooked. Such
10 configurations, although successful in the sense that they perform the desired function, are difficult to manufacture and prone to breakdown. Accordingly, there has been a need for a method and apparatus to make shaped fried food products (bowl-shaped snack food chips in particular) that
15 is less complex and easier to operate than has been the case in the past.

SUMMARY OF THE INVENTION

The method and apparatus according to the invention satisfy this need. In particular, the invention features
20 frying bowl- or scoop-shaped chip preforms by placing the preforms in bowl-shaped mold cavities to give the preforms a bowl shape, and filling the bowls of the preforms with hot oil to cook the chip preforms "from the inside."
Preferably, the preforms are only partially cooked while
25 in the mold cavities, i.e., to a moisture content at which

they are able to retain their bowl shape independent of the cavities. At that point, the preforms are removed from the cavities and cooked until completion in a second cooking step.

5 Thus, in a first aspect, the invention features a method of making a bowl-shaped snack food product. The method includes placing chip preforms made from uncooked dough in upwardly concave bowl-shaped mold cavities such that the chip preforms are formed into a bowl shape. The
10 bowl-shaped preforms are then at least partially filled with oil that is hot enough to fry the dough such that the preforms are partially cooked by means of the hot oil. The partially cooked preforms are then removed from the mold cavities and cooked to completion in a second cooking
15 step.

 In preferred embodiments, the preforms are fried in the first cooking step only until they are able to retain their bowl shape when removed from the mold cavities, i.e., when they have reached a predetermined moisture
20 content. Furthermore, lower portions of the chip preforms may be disposed in hot oil so that the preforms are cooked "from the outside" of the bowl. This may be accomplished by having the mold cavities perforated and dipping the bottom portions of the mold cavities in hot oil. The chip
25 preforms may be removed from the mold cavities by

inverting the mold cavities, preferably while simultaneously pushing the preforms out of the cavities by means of ejector members which extend into the mold cavities.

5 Preferably, the preforms are cooked to completion in a second vat of hot oil. They may be removed from the vat of hot oil by a conveyer that extends out of the vat. Preferably, the preforms are given a desired open-end-down configuration by being dunked or
10 submerged more deeply into the oil and then allowed to float back up to the surface of the oil, with hydrodynamic drag forces causing the bowl-shaped preforms to become inverted as they float up.

 In another aspect, the invention features a method of
15 making a bowl-shaped snack food product, in which method chip preforms made of uncooked dough are disposed in upwardly concave, bowl-shaped mold cavities such that they are formed into a bowl shape, and the bowl-shaped preforms are not restrained within the cavities. The unrestrained
20 preforms are then at least partially fried while in the mold cavities, e.g., by being filled with hot oil. Preferably, the preforms are simultaneously fried by having their lower portions partially emerged into a vat of hot oil.

In yet another aspect, the invention features a method of making a bowl-shaped snack food product, in which bowl-shaped chip preforms, which are able to retain their bowl shape independently of any forming means, are
5 disposed in a vat of hot oil to fry the dough and fried until they are fully cooked.

In a still further aspect, the invention features a method of removing cooked food product pieces from a vat of a cooking medium, e.g. hot oil, with a desired
10 orientation to facilitate draining of the pieces. The food product pieces are submerged more deeply in the cooking medium as they float downstream in the medium, and hydrodynamic drag forces cause the food product pieces to assume a desired orientation as they float up to the
15 surface.

In another aspect, the invention features an apparatus for making bowl-shaped food product. The apparatus includes a housing and a plurality of mold bodies disposed within the housing. The mold bodies each
20 have one or more upwardly opening bowl-shaped cavities into which chip preforms made from uncooked dough are placed to give the chip preforms a bowl shape. The apparatus includes a cooking medium distribution system, e.g. an array of nozzle pipes, located above the mold
25 bodies to fill the bowl-shaped preforms with a first

cooking medium, e.g. hot oil, thereby cooking the preforms from the insides thereof.

Preferably, the mold bodies are configured to move through the housing, e.g., by having several mold bodies
5 linked together into an endless belt which is disposed within the housing. Preferably, the apparatus is configured such that lower portions of the mold cavities are immersed into a vat or pool of hot oil and the mold cavities have perforated walls which allow hot oil to flow
10 up into the cavities from below, thereby cooking the chip preforms from below, i.e., from the outside of the bowls. Preferably, the apparatus is configured such that the preforms are filled with the cooking medium from above before the preforms are partially immersed into the medium
15 below.

In preferred embodiments, the mold bodies are connected in an endless belt which is trained around one or more ejector wheels. The ejector wheels extend partially up into the cavities through slots in the
20 bottoms of the cavities to help eject the partially cooked preforms from the cavities.

The apparatus may include a conveyor assembly which transports the preforms to the mold bodies, and an air cushion transfer chute which transfers the chip or
25 preforms from conveyor assembly into the mold cavities.

The apparatus may further include a secondary cooking station where cooking of the chip preforms is completed, e.g., a vat for forming a pool or a bath of a second cooking medium such as hot oil. The chip preforms may be removed from the vat by means of a conveyor extending out of the vat, and preferably the vat has a chip orienting means that gives the chips a desired orientation before they are carried out of the hot oil, e.g., a reciprocating plunger which dunks the snack food product pieces and allows them to float back up to the surface with hydrodynamic forces (drag) causing the snack food product pieces to assume the desired orientation.

BRIEF DESCRIPTION OF THE DRAWINGS

The invention will now be described in greater detail in connection with the drawings, in which coiling

Fig. 1 is a schematic plan view of an apparatus for making bowl-shaped snack food products according to the invention;

Fig. 2 is a schematic perspective view showing the sheeting and die-cutting portion of the apparatus shown in Fig. 1;

Figs. 2A and 2B are a side elevation view and a flat pattern view, respectively, of the cutter roller shown in Fig. 2;

Fig. 3 is a schematic perspective view showing an air slide conveyor arrangement according to the invention;

Figs. 3A and 3B are a section view and a detailed view, respectively, of the air slide taken along the lines
5 3A-3A and 3B-3B, respectively, in Fig. 3;

Figs 4A, 4B, and 4C are schematic side elevation, plan, and end views, respectively, of the partial fryer shown in Fig. 1;

Fig 5. is a schematic perspective view showing three
10 mold plate links in a continuous belt of mold plates in which bowl-shaped snack food products are made according to the invention;

Fig. 6 is a schematic perspective view of a conformal oil pan used in the partial fryer shown in Fig. 1;

15 Fig. 7 is a schematic view showing hot oil filling and cooking bowl-shaped chip preforms with oil according to the invention;

Fig. 8 is a schematic detail view showing a baffle or flow diverter used to reduce the force of impact of the
20 oil filling the bowl-shaped preforms in Fig. 7;

Fig. 9 is a schematic perspective view showing sprocket drive wheels and ejector wheels used in the partial fryer shown in Fig. 1;

Fig. 10 is a schematic section view, taken along the lines 10-10 in Fig. 1, showing the operation of the ejector wheels of Fig. 9;

5 Figs. 11A and 11B are a schematic side elevation view and a plan view, respectively, of the secondary fryer shown in Fig. 1.

DETAILED DESCRIPTION OF PREFERRED EMBODIMENTS

A schematic plan view of a preferred embodiment of the invention is shown in Fig. 1. The apparatus 10
10 includes a sheeting and die-cutting portion 12; an air slide 14; a partial fryer 16; a transfer conveyor 18; a secondary fryer 20; and a final product take-away conveyor 22.

As shown in Fig. 2, the sheeting and die-cutting
15 portion 12 includes at least one pair of sheeter rollers 24, 26 and a cutter roller 28, which is shown in greater detail in Figs. a, b, and 2C. Corn masa, which has been fed to a masa "hog" or hopper from a set of grinding stones along with a secondary stream of water to achieve a
20 moisture content of approximately 49.5% and an average grain size of approximately 0.024 inch, is fed between the sheeter rollers 24, 26 as is known in the art. The sheeter rollers 24, 26, which rotate in the directions indicated by arrows 28, 30, are separated by a gap 32 on

the order of 0.032 inch to form a sheet of masa which preferably is on the order of 0.032 inch thick.

Preferably, the width of the gap 32 is adjustable. Cutter roller 28, which rotates in the direction shown by arrow 34, has upstanding, preferably circular die-cutting ridges 36, as shown in Figs. 2A and 2B (but not in Fig. 2). The cutter roller 28 is positioned such that the die-cutting ridges 36 contact the surface of sheeter roller 26. Thus, as the corn masa (or any other dough that might be used with the invention) is sheeted between the rollers 24, 26 and wraps around the bottom portion of the roller 26, it is cut into circular dough preforms 40 (Fig. 1), much like cutting dough with a cookie cutter and as generally is known in the art.

As further shown in Fig. 2, the sheeting and die-cutting portion 12 includes a preform removal assembly 42 (not shown in Fig. 1). The preform removal assembly 42 consists of a support bar 44 or equivalent support member that is attached in front of sheeter roller 26, preferably to the frame (not shown) supporting the sheeter and die-cutter rollers. A set of wing knives 46 is secured to support bar 44, with one wing knife 46 for each "column" of chip preforms formed by the cutter roller 28. The wing knives 46 taper in width from the support bar 44 to their tips 48, which are disposed against the surface of the

sheeter roller 26. As the sheeter roller 26 rotates with the corn masa sheet clinging to it, the wing knives 46 lift the circular chip preforms 40 from the surface of the sheeter roller 26, and the preforms drop onto conveyor belt 50. The masa "lace," i.e., the part of the masa sheet surrounding the chip preforms, rotates back around into the gap 32 and is mixed with additional masa being fed between the sheeter rollers.

Preferably, the cutter roller 28 is configured such that the chip preforms formed by the cutting ridges 36 are laterally evenly spaced, i.e., along the length of the sheeter rollers or, in other words, transverse to the direction of travel of the conveyor 50 as shown in Fig. 1. Furthermore, it is essential that the cutter roller 28 be configured such that the chip preforms in each of the columns be aligned in rows extending transversely across the conveyor 50, as shown in Fig. 1 as well.

The conveyor 50 transports the chip preforms 40 to the partial fryer 16. As described in greater detail below, the partial fryer 16 has a continuous belt of perforated mold plates having mold cavities formed therein, one of which mold plates is shown in Fig. 3. As further shown in Fig. 3, the air slide 14 is positioned at the downstream end of the conveyor 50 and is located just

above the mold plates, at the leftmost end of the partial fryer 16 as it is shown in Fig. 1.

As illustrated in Fig. 3A, the air slide 14 is formed from sheet metal which defines a plenum or chamber 56.

5 The plenum 56 is bounded by a back wall 58 and a perforated front or slide wall 60. The ends of the plenum 56 are bounded by end plates 62 (Fig. 3), and guide rails 64 are attached to the front of slide wall 60, e.g., by welding. The end plates 62 extend slightly above the
10 slide wall 60 such that they, along with the guide rails 64, help guide the chip preforms into the mold cavities.

Air inlet pipes 66 and 68 extend into the plenum 56 through apertures in the respective end plates 62 and are secured therein, e.g., by welding. Pressurized air is
15 pumped into the plenum 56 through the air inlet pipes and, as shown in Fig. 3A, flows out of the plenum 56 through perforations 70 in the front or slide wall 60. This creates a slight cushion of air above the surface of the air slide 14 which helps the chip preforms 40 slide
20 smoothly and cleanly into the mold cavities, much like an "air hockey" disk sliding over an "air hockey" table.

As shown in Fig. 3B, the perforations 70 are drilled, e.g., by laser, so that they have a generally inverted teardrop profile. This helps direct the air flowing out
25 of the plenum downward along the surface of the front or

slide wall 60, as opposed to straight through or perpendicular to the wall. This feature is important (as, in general, is the air cushion provided by the air slide) in order to ensure that the chip preforms 40 slide smoothly into their respective mold cavities. This prevents them from blowing upward off of or dragging along the air slide 14, either of which could cause the preforms to get folded over in the mold cavities, thereby leading to deformed, wasted product.

The centerpiece of the apparatus according to the invention is the partial fryer 16, which is shown in detail in Figs. 4A, 4B, and 4C. As noted above, the partial fryer 16 includes a continuous belt of perforated mold plates with mold cavities formed therein, as shown in greater detail in Fig. 5. The "links" of the continuous belt 72 are each composed of a perforated mold plate 74. The mold plates 74 are formed, e.g., from aluminum stock on the order of one sixteenth inch thick and have a multitude of perforations 76 extending through the stock. Each of the mold plates 74 has a number of mold cavities 78, e.g. 3, formed as circular depressions in the plate.

Each mold plate 74 is attached to (e.g. by screws or rivets not shown) and supported by a pair of support members 80. A pair of pins or axles (not visible in Fig. 5) extends laterally from each support member 80. A

spacer plate 82 fits over the two pins or axles and against each of the support members 80. Link members 84 are then fitted over the adjacent pins or axles of adjacent support members so as to "straddle" two adjacent support members and link them together. Roller bearing spacers 86 are then placed over the pins or axles, followed by link members 88 which, like link members 84, fit over adjacent pins or axles extending from adjacent support members to straddle, and thereby link, adjacent support members. Finally, retainer links 90 are fit over the ends of each pair of pins or axles and are secured thereto, e.g., by flattening the ends 92 of the pins or axles. In this manner, the continuous chain or belt of mold plates is assembled, with each link of the chain constituting a mold plate with mold cavities 78.

As shown in Figs. 4A and 4C, the belt 72 is trained around and driven by sprocket drive wheels 96, 98 at either end of the partial fryer 16 (Fig. 4A) and travels through a frying chamber 100 extending through the middle of and substantially along the length of partial fryer 16 (Fig. 4C). The pins or axles extending from the support members 80 should be spaced relative to each other such that the roller bearing spacers 86 are all evenly spaced, as illustrated in Fig. 4A, and the roller bearing spacers 86 should have a large enough diameter such that

they support the belt 72 on upper and lower guide rails 102 and 104 which extend along the walls of the frying chamber 100.

In addition to the belt 72 of mold plates, another
5 primary component of the partial fryer 16 is an oil
distribution manifold system 110. The oil distribution
manifold system includes a central distribution conduit
112 with oil nozzle pipes 114 branching off of and
extending down from the central distribution conduit 112.
10 The oil nozzle pipes are arranged in an array over the
belt 72, with the same number of "columns" of pipes in the
array as there are mold cavities 78 in each plate 72.

The partial fryer 16 also includes heaters (not
shown) which heat frying oil to the desired temperature,
15 and requisite plumbing, e.g., pump system 116 and conduit
118 leading from the pump 116 to the central oil
distribution conduit 112. Thus, hot oil is circulated
through the partial fryer by being pumped through conduit
118 into central distribution conduit 112, and then
20 flowing freely through and out of the oil nozzle pipes 114
as the belt 72 travels under the outlets from the pipes.
The hot oil is collected by oil return pan 120 and
returned to the pump system 116 by appropriate drain means
(not shown).

As explained in greater detail below, the chip preforms are carried through the partial fryer 16 in the mold cavities 78 and are partially fried by hot oil showering down on them from the oil nozzle pipes 114.

5 Additionally, the chip preforms preferably are cooked from below by being carried through a bath of hot oil, which is able to flow up and around the preforms in the bowl-shaped mold cavities 78 through the apertures 76 in the mold plates and through release slots 122 in the bottoms of the
10 mold cavities 78 (Fig. 4), the primary purpose of which will be described below. The bath of hot oil is formed by controlling the flow rate of oil through the system such that oil pools below the preforms contained within the open mold cavities. To reduce the volume of oil that must
15 be pooled, it is preferable to use a conformal oil pan 124 positioned below the upper flight of the belt 72. See Figs. 4C, 6, and 7. Advantageously, a minimum amount of oil remains inside the fryer, thereby maximizing "oil turnover" and helping to prevent oil degradation. Oil
20 spilling over the edges or ends of the conformal oil pan 124 is caught by the collector pan 120 and recirculated through the system.

Thus, it will be understood that the chip preforms are transferred from the conveyor 50 into the open mold
25 cavities 78 by sliding down along the air slide 14 into

the mold cavities, as shown in Figs. 1 and 3, and then they are partially cooked in the partial fryer 16 as they are transported under a cascade of hot oil which fills the chip preforms from above to cook the bowl-shaped preforms from the inside. Additionally, the chip preforms are lowered into a pool of hot oil so that hot oil flows up and around the preforms from below to cook the bowl-shaped preforms from the outside. This approach to cooking the chip preforms -- cooking them with oil both inside the bowl and outside the bowl -- is preferred so as to avoid differential cooking, i.e., cooking from one side only, which can cause the final bowl-shaped chips to crack.

Preferably, the partial fryer 16 is constructed with the downstream end of the conformal pan 124 at a lower elevation than the upstream end. Additionally, the flow rate of oil preferably is controlled so that the pool of hot oil does not extend as far to the left (Fig. 4A) as the array of oil nozzle pipes 114 does. As a result, the bowl-shaped chip preforms begin to be filled with oil from above before they are partially immersed in the pool of hot oil below. This prevents the preforms from being floated up in the mold cavities by the oil bath below, which would ruin their bowl shape.

As shown in Fig. 8, it is preferable to attach a small baffle or flow diverter 130, e.g. a small vane, to

the end of the oil nozzle pipes 114 (at least in the upstream-most row of oil nozzle pipes) such that the baffle or flow diverter 130 deflects or breaks up the flow of oil streaming out of the pipes 114. This prevents the oil from striking the uncooked chip preforms so hard that it tears them, particularly on the edges of the release slots 122 at the bottom of the mold cavities and more particularly before the preforms are partially immersed in oil from below.

Furthermore, as shown in Fig. 7, it is preferable that only about the lower third of the chip preforms are immersed in the bath of hot oil. This is because the chip preforms receive sufficient oil from above (i.e., inside the bowl) to be fried sufficiently from the bowl side, and immersing the mold cavities more deeply into the oil tends to cause the preforms to float up and out of the mold cavities.

The chip preforms are only partially cooked in the partial fryer 16. In particular, they are cooked just until they are sufficiently rigid to retain their bowl shape independent of the mold cavities 78. Thus, in a preferred embodiment of the invention using corn masa with an uncooked moisture content of 49.5%, an oil temperature of 360° F, and an oil flow rate through the system of six to eight gallons per minute with the velocity kept as low

as possible to prevent tearing the preforms, the chip preforms will be fried to the desired, partially cooked state within approximately ten to fifteen seconds residence time in the hot oil. It should be noted, e.g., in Fig. 4A, that hot oil cascades down from the oil nozzle pipes 114 into the bowl-shaped preforms along most of the length of the partial fryer 16. This keeps the preforms filled with hot oil as they travel through the fryer and oil boils away, thereby ensuring that the temperature of the oil inside the bowls is elevated.

The length of the partial fryer 16 or, more easily, the linear speed of the belt 72 can be adjusted to control the residence time of the chip preforms in the oil. The rotational speeds of the sheeter and cutter rollers and the linear speed of the conveyor belt 50 used to transport the chip preforms from the sheeting/die-cutting rollers to the air slide 14 and into the mold cavities are also adjusted as the speed of the belt 72 is adjusted such that all of the above-mentioned units are synchronized. This is so that the chip preforms are centered when they slide into the mold cavities.

Once the preforms are partially cooked to the desired state, e.g., to a moisture content on the order of 15% - 20%, they are "ramped up" out of the oil at the downstream end of the partial fryer 16 as the belt 72 rises along the

guide rail 102. As the mold plates 74 rotate around the sprocket drive wheels 98, the mold cavities are inverted and the partially cooked chip preforms are dumped out onto conveyor 18 (Fig. 1).

5 As shown in Fig. 9, the sprocket drive wheels 98 (shown schematically without teeth) are mounted on shaft 140 coaxially with a set (e.g. three, corresponding to the number of mold cavities 78 in each mold plate 74) of ejector disks 142. As shown in Fig. 10, the ejector disks
10 142 extend slightly into the mold cavities 78 through release slots 122 and the bottoms of the cavities 78 as the mold plates 74 move into engagement with and rotate around the sprocket drive wheels 98. This helps dislodge any chips which may be stuck in the mold cavities.

15 As the mold cavities are inverted and the ejector disks extend through the release slots into the mold cavities, the partially fried chips 146 (Fig. 1) are dumped onto transfer conveyor 18. At this point in time, the chips 146 are sufficiently cooked to maintain their
20 bowl shape outside of or independent of the mold cavities. The transfer conveyor 18 transports the partially cooked, bowl-shaped chips 146 to secondary fryer 20, where the partially fried chips are dropped into another fryer 148. Preferably, the transfer conveyor 18 is a wire mesh or
25 chain link belt, which allows oil to drain from the chips.

As shown in Figs. 11A and 11B, the secondary fryer 20 comprises an elongated vat of hot oil 148. A pair of submergers 152, 154 are provided to submerge the chips and keep them submerged in the hot oil 148, as generally is known in the art. The submergers rotate in the direction indicated by arrows 156, 158, respectively, thereby moving the chips from right to left as shown in Figs. 11A and 11B. Other means (not shown) may also be provided to circulate the oil in that direction.

10 A chip orientation device 156 is located downstream of the submergers. The chip orientation device is provided to ensure that the chips are removed from the oil 148 by the take-away conveyer 22 bowl-side down. By having the chips so oriented, oil drains from the chips more thoroughly and does not settle or sit in the bowl of the chips, which can lead to over-cooking of the chips and/or to oil-soaked chips.

The chip orientation device 156 consists of a basket 160 that is made from wire mesh or perforated sheet metal. 20 The basket 160 is supported in the oil by plunger shaft 162 which, in turn, is supported by plunger driver 164. The plunger driver plunges the basket 160 up and down, into and out of the oil bath. As the basket 160 submerges, it pushes the bowl-shaped chips deeper into the oil. Then, as the basket moves upward, the chips float up 25

toward the surface of the oil. As they do so,
hydrodynamic forces on the chips automatically cause the
chips to float up towards the surface with their bottoms
up, i.e., with the open ends facing down. Preferably, the
5 basket 160 is retracted upward faster than the chips float
upward so that the chips are permitted to return toward
the surface in an unhampered manner. Furthermore, the
basket 160 preferably is oscillated up and down at a
frequency on the order of two cycles per second, although
10 the actual value will depend, for example, on the rate at
which chips are moving through the system; chip volume;
oil viscosity, velocity, and volume; fryer dimensions;
etc.

As the chips float up toward the surface, they also
15 continue to move downstream. They are then lifted out of
the oil by the take-away conveyor 22, which carries the
chips downstream for further processing, e.g. seasoning
and packaging. Preferably, the final product take-away
conveyor 22 is formed from wire mesh or metal links, and
20 it may be formed from several stepped or staggered
sections to facilitate draining of the oil from the chips
as they tumble over the steps of the conveyor.

In general, the bath of oil 148 should be maintained
at a temperature on the order of 360° F. The length of
25 the secondary fryer 20 and/or the rate at which the chips

move through the fryer is/are tailored such that for tortilla chips made from corn masa, the chips reside in the secondary fryer for approximately thirty-five to forty seconds. A final moisture content of the chips of 1.1% is
5 most desirable, but a final moisture content of 0.6% to 2.4% is deemed to be acceptable. The oil residence time and oil temperatures in the partial fryer 16 and secondary fryer 20, as well as the intermediate and final product moisture content will, of course, vary somewhat depending
10 on the particular type of snack food chips being manufactured.

With the above-described apparatus configuration and method, bowl-shaped snack food products, e.g. chips, can be made quickly, easily, and efficiently. Furthermore, by
15 partially frying the chips in a partial fryer and then transferring the chips to a secondary fryer for completion of the cooking, the layout of the apparatus can be modified to take up relatively little floor space in the manufacturing facility. Additionally, the above-described
20 configuration reduces the overall length of the processing line, which reduces the amount of oil being used. With less oil being used, it becomes easier to maintain the quality of the oil, which is recirculated through use, and hence the quality of the final product.

Other embodiments and configurations are deemed to be within the scope of the following claims.

CLAIMS

1 1. A method of making a bowl-shaped snack food
2 product, said method comprising:
3 disposing chip preforms made of uncooked dough in
4 upwardly concave, bowl-shaped mold cavities, said chip
5 preforms each thereby being formed into a bowl shape;
6 at least partially filling said bowl-shaped chip
7 preforms with oil that is hot enough to fry the dough;
8 partially cooking said chip preforms, by means of the
9 hot oil inside the bowl of the preforms, in a first
10 cooking step;
11 removing said partially cooked chip preforms from
12 said mold cavities; and
13 completing cooking of said chip preforms in a second
14 cooking step.

1 2. The method of claim 1, wherein said chip preforms
2 are fried in said first cooking step only until said chip
3 preforms are able to retain their bowl shape when removed
4 from said mold cavities.

1 3. The method of claim 1, wherein said chip preforms
2 are fried in said first cooking step only until said chip
3 preforms have a predetermined moisture content.

1 4. The method of claim 1, further comprising
2 disposing lower portions of said chip preforms in oil hot
3 enough to fry the dough, during said first cooking step,
4 so as to cook said chip preforms by means of hot oil
5 exterior to the bowl of the preforms.

1 5. The method of claim 4, wherein said mold cavities
2 have perforations which permit oil to flow therethrough,
3 said method comprising transporting said mold cavities
4 through a vat of hot oil with lower portions of said mold
5 cavities and said lower portions of said chip preforms
6 partially immersed in said vat of hot oil.

1 6. The method of claim 1, wherein said partially
2 cooked chip preforms are removed from said mold cavities
3 by inversion of said cavities.

1 7. The method of claim 1, wherein said partially
2 cooked chip preforms are pushed out of said mold cavities
3 by means of ejector members extending into said mold
4 cavities.

1 8. The method of claim 1, further comprising frying
2 said chip preforms in a vat of hot oil in said second

3 cooking step and removing said chip preforms from said vat
4 of hot oil when said chip preforms are fully cooked.

1 9. The method of claim 8, wherein said fully cooked
2 chip preforms are removed from said vat of hot oil by
3 means of a conveyor apparatus partially submerged in and
4 extending out of said vat of hot oil.

1 10. The method of claim 9, further comprising
2 causing said chip preforms to be oriented in a desired
3 orientation before said chip preforms are removed from
4 said vat of hot oil.

1 11. The method of claim 10, wherein said chip
2 preforms are caused to be oriented with the open portion
3 of the bowl shapes facing downward before said chip
4 preforms are removed from the vat of hot oil.

1 12. The method of claim 11, wherein said chip
2 preforms are caused to be oriented with the open portion
3 of the bowl shapes facing downward, before said chip
4 preforms are removed from the vat of hot oil, by
5 submerging said chip preforms more deeply in said vat of
6 hot oil and allowing said chip preforms to float up toward
7 the surface of the vat of oil, with hydrodynamic forces

8 causing said chip preforms to assume said open-end-down
9 orientation as they float up toward the surface of the vat
10 of oil.

1 13. The method of claim 1, wherein said uncooked
2 dough chip preforms are transported to said mold cavities
3 on a conveyor and are slid along an air-cushioned transfer
4 chute into said mold cavities.

1 14. A method of making a bowl-shaped snack food
2 product, said method comprising:
3 disposing chip preforms made of uncooked dough in
4 upwardly concave, bowl-shaped mold cavities, said chip
5 preforms each thereby being formed into a bowl shape, said
6 bowl-shaped chip preforms being unrestrained within said
7 mold cavities; and
8 at least partially frying said chip preforms while in
9 said mold cavities.

1 15. The method of claim 14, wherein said bowl-shaped
2 chip preforms are at least partially fried by being filled
3 with hot oil.

1 16. The method of claim 14, wherein said mold
2 cavities have perforations which permit oil to flow

3 therethrough, said method comprising transporting said
4 mold cavities through a vat of hot oil with lower portions
5 of said mold cavities and lower portions of said chip
6 preforms partially immersed in said vat of hot oil.

1 17. The method of claim 14, wherein said uncooked
2 dough chip preforms are transported to said mold cavities
3 on a conveyor and are slid along an air-cushioned transfer
4 chute into said mold cavities.

1 18. A method of making bowl-shaped snack food
2 product, said method comprising:
3 disposing bowl-shaped chip preforms made of dough in
4 a vat of oil hot enough to fry the dough, said bowl-shaped
5 chip preforms being able to retain their bowl shape
6 independently of any forming means;
7 frying said chip preforms in said vat of hot oil
8 until the preforms are fully cooked; and
9 removing said chip preforms from said vat of hot oil.

1 19. The method of claim 18, wherein said fully
2 cooked chip preforms are removed from said vat of hot oil
3 by means of a conveyor apparatus partially submerged in
4 and extending out of said vat of hot oil.

1 20. The method of claim 19, further comprising
2 causing said chip preforms to be oriented in a desired
3 orientation before said chip preforms are removed from
4 said vat of hot oil.

1 21. The method of claim 20, wherein said chip
2 preforms are caused to be oriented with the open portion
3 of the bowl shapes facing downward before said chip
4 preforms are removed from the vat of hot oil.

1 22. The method of claim 20, wherein said chip
2 preforms are caused to be oriented with the open portion
3 of the bowl shapes facing downward, before said chip
4 preforms are removed from the vat of hot oil, by
5 submerging said chip preforms more deeply in said vat of
6 hot oil and allowing said chip preforms to float up toward
7 the surface of the vat of oil, with hydrodynamic forces
8 causing said chip preforms to assume said open-end-down
9 orientation as they float up toward the surface of the vat
10 of oil.

1 23. A method of removing cooked food product pieces
2 from a vat of a cooking medium, said method comprising:
3 transporting said food product pieces through said
4 vat by said cooking medium;

5 submerging said food product pieces more deeply in
6 said cooking medium;
7 allowing said food product pieces to float up toward
8 the surface of said cooking medium with hydrodynamic
9 forces causing said food product pieces to assume a
10 desired orientation; and
11 removing said food product pieces by means of a
12 conveyor partially submerged in and extending out of the
13 vat of said cooking medium.

1 24. The method of claim 23, wherein said food
2 product pieces each have a bowl shape and said desired
3 orientation is open-end-down.

1 25. An apparatus for making a bowl-shaped snack food
2 product, said apparatus comprising:
3 a housing;
4 a plurality of mold bodies disposed within said
5 housing, said mold bodies each having one or more upwardly
6 opening, bowl-shaped mold cavities formed therein for
7 receiving chip preforms made of uncooked dough and for
8 shaping each of said chip preforms into a bowl shape; and
9 a cooking medium distribution system disposed above
10 said mold bodies so as to fill bowl-shaped chip preforms
11 disposed within said mold cavities with a first cooking

12 medium from above, thereby cooking said chip preforms from
13 the inside of the bowl formed thereby.

1 26. The apparatus of claim 25, wherein said mold
2 bodies are configured to move through said housing.

1 27. The apparatus of claim 26, wherein said mold
2 bodies are linked together to form an endless belt of mold
3 bodies, at least part of said endless belt being disposed
4 within said housing.

1 28. The apparatus of claim 25, wherein said mold
2 cavities have perforated walls which allow said first
3 cooking medium to flow therethrough.

1 29. The apparatus of claim 28, further comprising a
2 pan disposed within said housing, below said mold bodies,
3 for forming a pool or bath of said first cooking medium,
4 said apparatus being configured such that bottom portions
5 of said mold cavities extend down into said pool or bath
6 of said first cooking medium such that said first cooking
7 medium flows through said perforated walls and cooks said
8 chip preforms from the outside of the bowls formed
9 thereby.

1 30. The apparatus of claim 29, wherein said
2 apparatus is configured such that said bowl-shaped chip
3 preforms are at least partially filled with said first
4 cooking medium from above before said bottom portions of
5 said mold cavities extend down into said pool or bath of
6 said first cooking medium.

1 31. The apparatus of claim 25, further comprising an
2 ejector mechanism which ejects cooked chip preforms from
3 said mold cavities after said chip preforms have been at
4 least partially cooked by said first cooking medium.

1 32. The apparatus of claim 31, wherein said mold
2 bodies are linked together to form an endless belt of mold
3 bodies which circulates at least partially within said
4 housing and wherein said mold cavities have slots formed
5 in bottom portions thereof, said endless belt being
6 trained around one or more ejector wheels which extend
7 into said mold cavities through said slots to eject said
8 at least partially cooked chip preforms.

1 33. The apparatus of claim 25, wherein said cooking
2 medium distribution system comprises an array of nozzle
3 pipes extending downward over said mold bodies and wherein
4 said mold bodies move translationally below said nozzle

5 pipes so as to carry said chip preforms through a shower
6 of said first cooking medium being distributed by said
7 nozzle pipes.

1 34. The apparatus of claim 33, wherein at least some
2 of said nozzle pipes have baffles on outlet ends thereof
3 to deflect, divert, or otherwise break up cooking medium
4 being ejected thereby, thereby reducing the force of
5 impact of said first cooking medium impinging against chip
6 preforms disposed within said mold cavities.

1 35. The apparatus of claim 25, further comprising
2 a conveyor assembly for transporting said chip
3 preforms to said mold bodies, and
4 an air-cushioned transfer chute disposed between said
5 conveyor assembly and said mold bodies for transferring
6 said chip preforms from said conveyor assembly into said
7 mold cavities.

1 36. The apparatus of claim 35, wherein said air-
2 cushioned transfer chute comprises a plenum into which air
3 is pumped, said plenum being defined by at least one
4 perforated wall along which said chip preforms slide.

1 37. The apparatus of claim 36, wherein said
2 perforated wall has teardrop-shaped perforations which are
3 configured to direct air at least partially along the
4 surface of said perforated wall in the direction in which
5 said chip preforms slide.

1 38. The apparatus of claim 25, further comprising a
2 secondary cooking station wherein cooking of said chip
3 preforms is completed.

1 39. The apparatus of claim 38, wherein said
2 secondary cooking station comprises a vat for forming a
3 pool or bath of a second cooking medium.

1 40. The apparatus of claim 39, further comprising an
2 exit conveyor disposed at least partially in and extending
3 out of said vat for removing cooked bowl-shaped snack food
4 product pieces from said pool or bath of said second
5 cooking medium.

1 41. The apparatus of claim 40, further comprising
2 chip orientation means for giving said cooked bowl-shaped
3 snack food product pieces a desired orientation before
4 said pieces are removed from said pool or bath of said
5 second cooking medium, said orientation means comprising a

6 reciprocating plunger which submerges said product pieces
7 more deeply in said second cooking medium and then allows
8 said product pieces to float up toward the surface of said
9 second cooking medium.

1 42. The apparatus of claim 41, wherein said desired
2 orientation of said bowl-shaped snack food pieces is open-
3 end-down and wherein said plunger reciprocates at a
4 frequency which allows hydrodynamic forces to cause said
5 snack food pieces to assume said desired orientation as
6 said snack food pieces float up toward the surface of said
7 second cooking medium.

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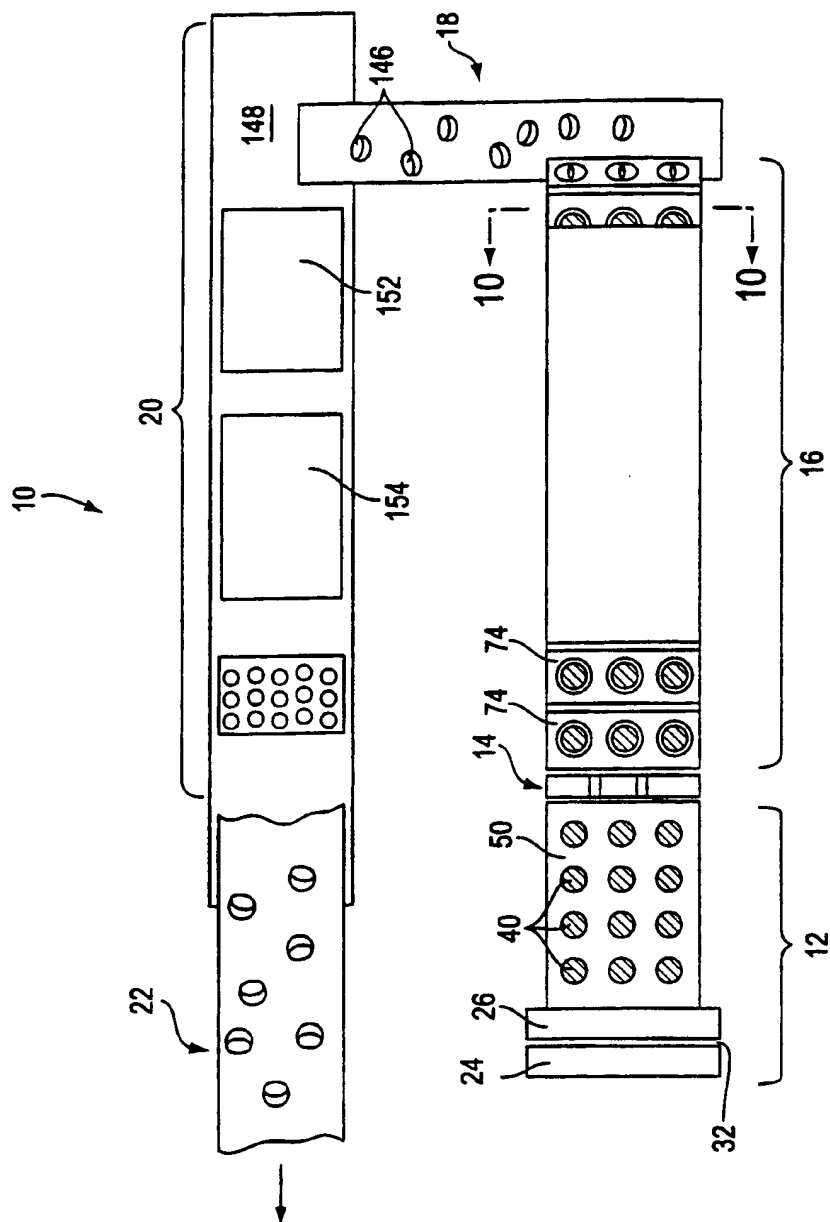


FIG. 1

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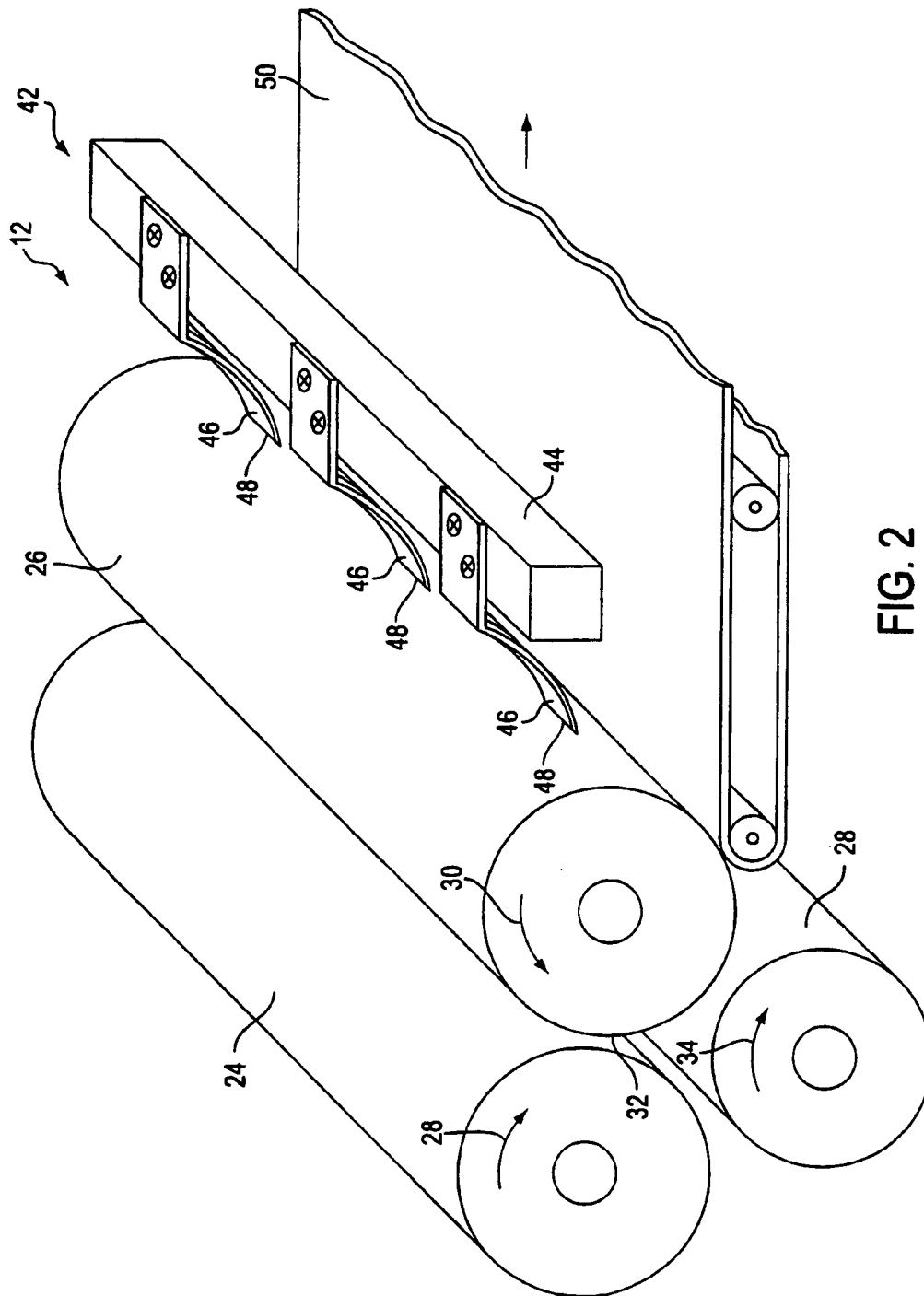


FIG. 2

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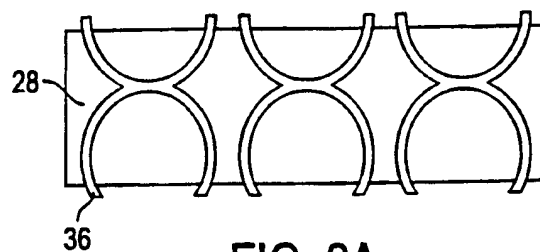


FIG. 2A

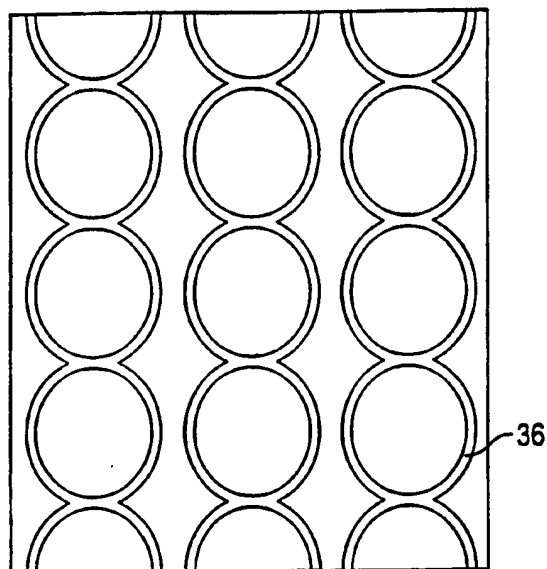
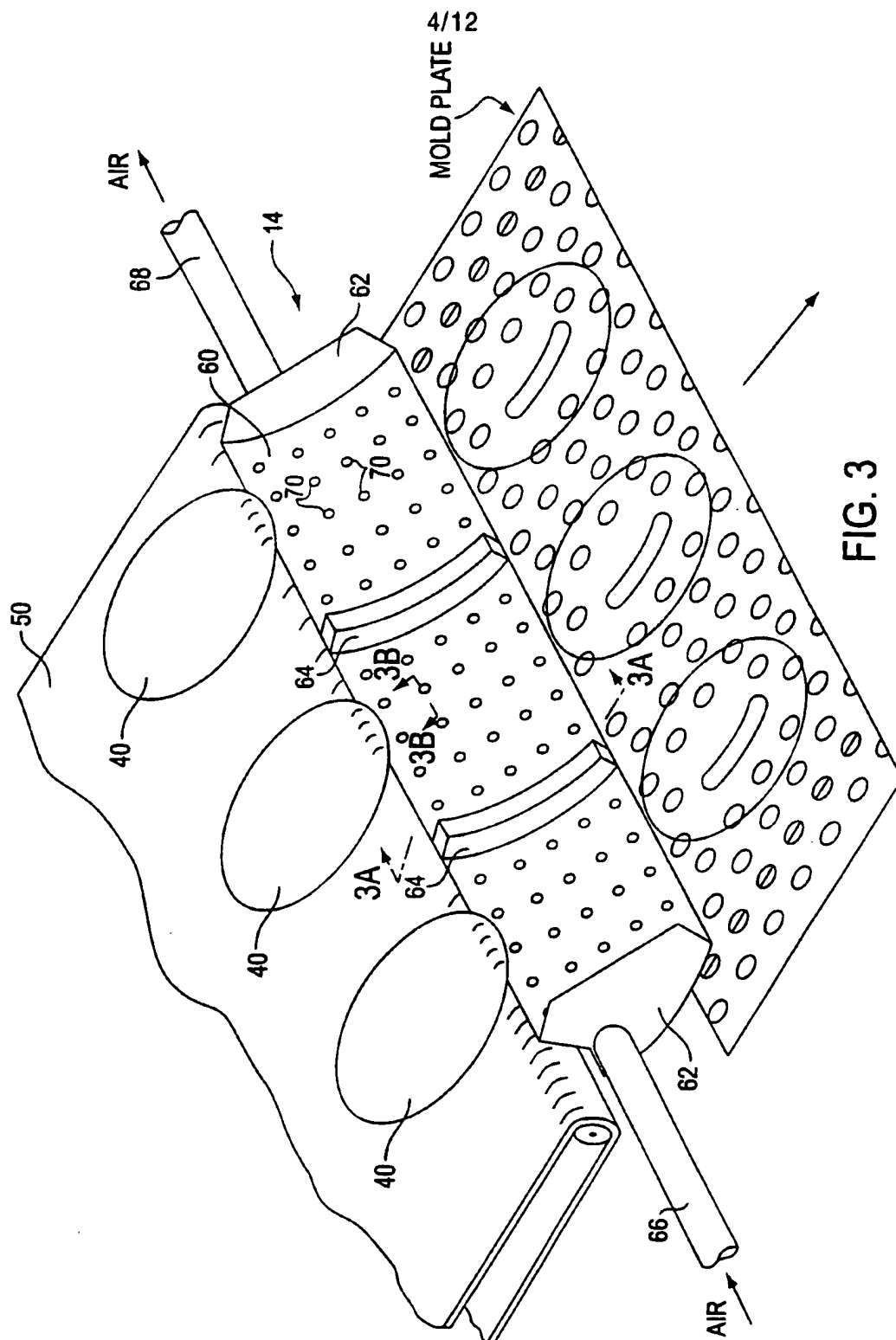


FIG. 2B

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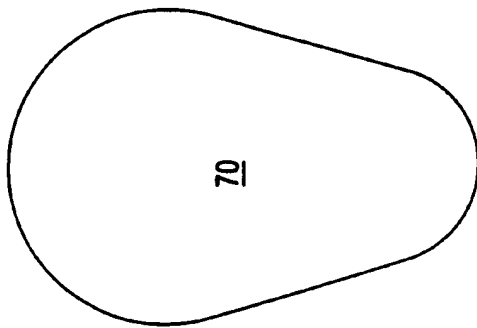


FIG. 3B

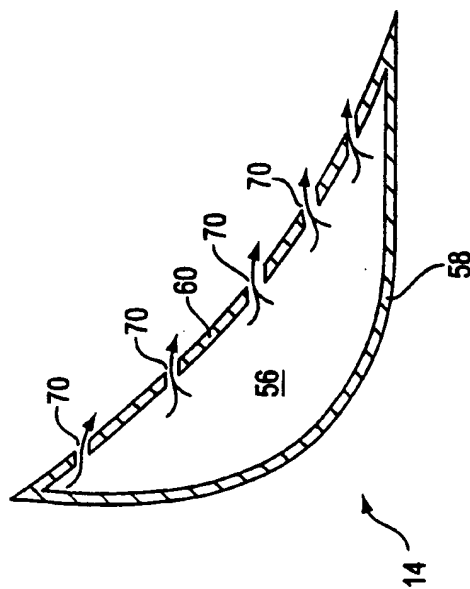


FIG. 3A

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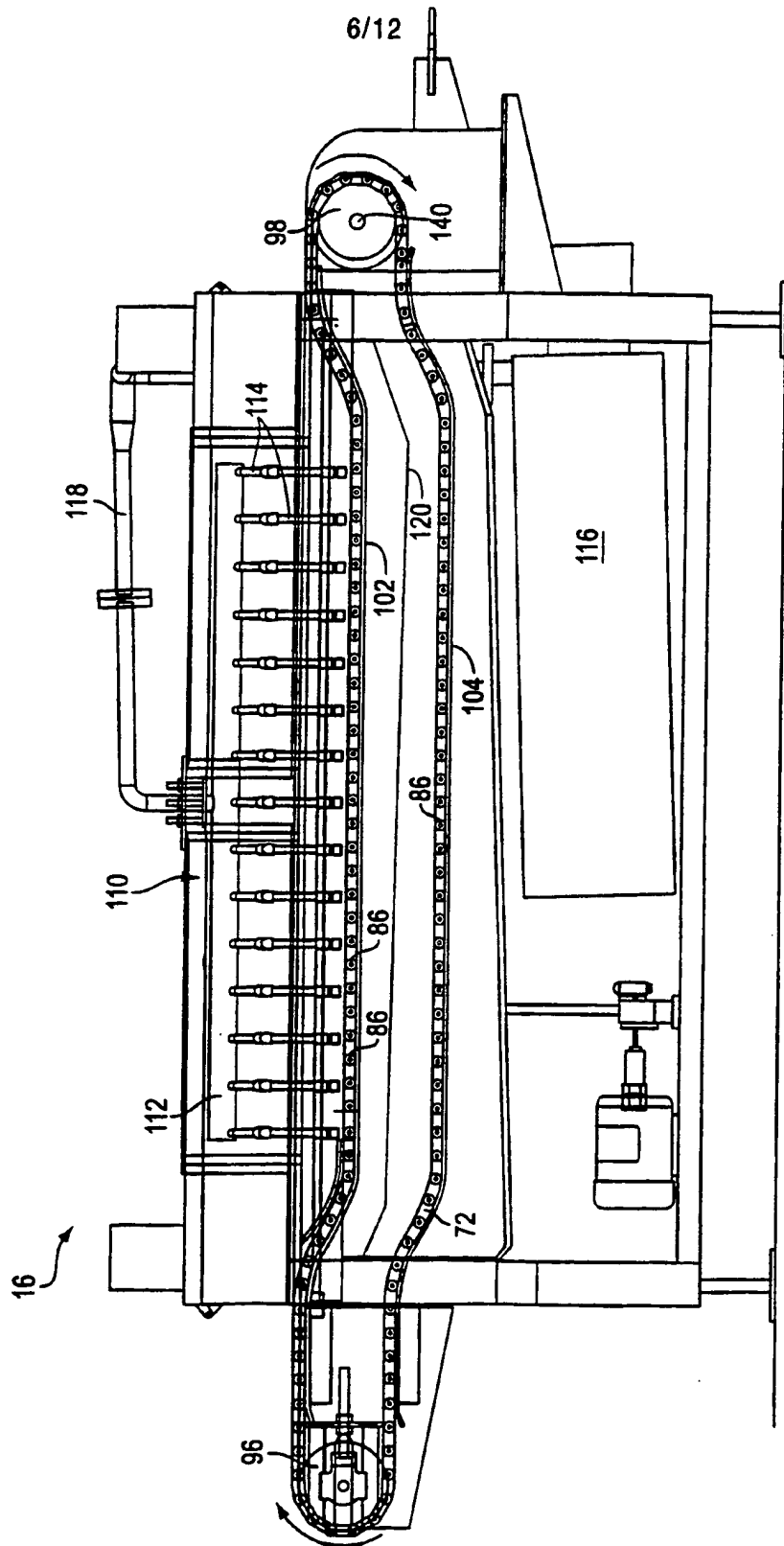


FIG. 4A

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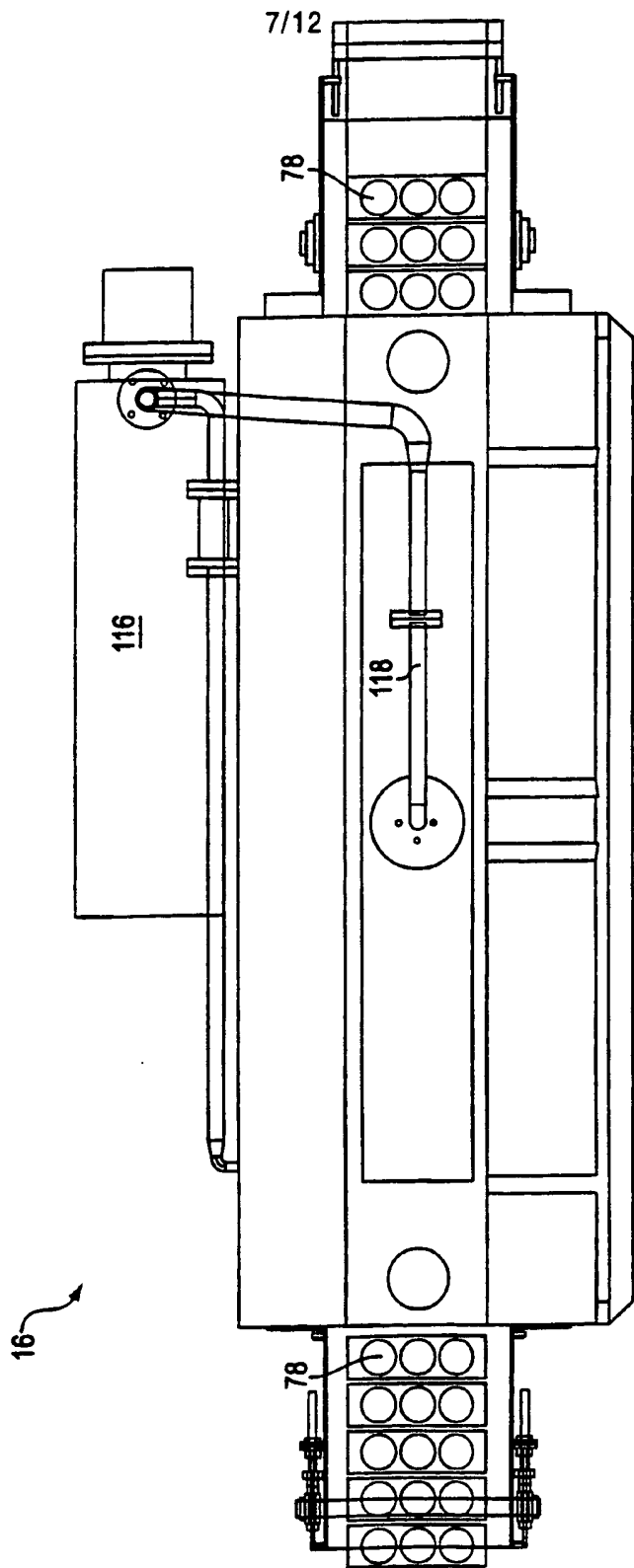


FIG. 4B

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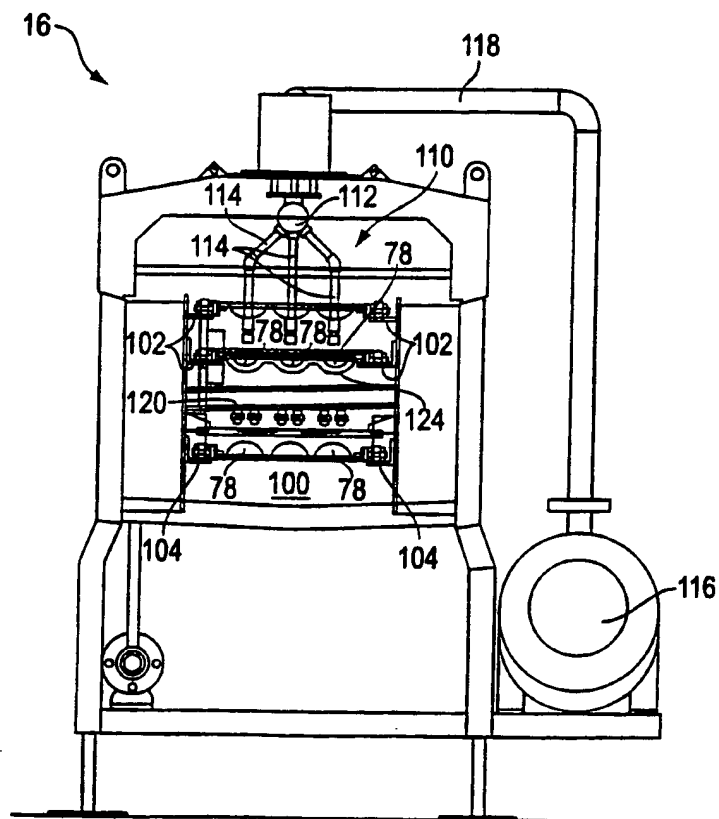


FIG. 4C

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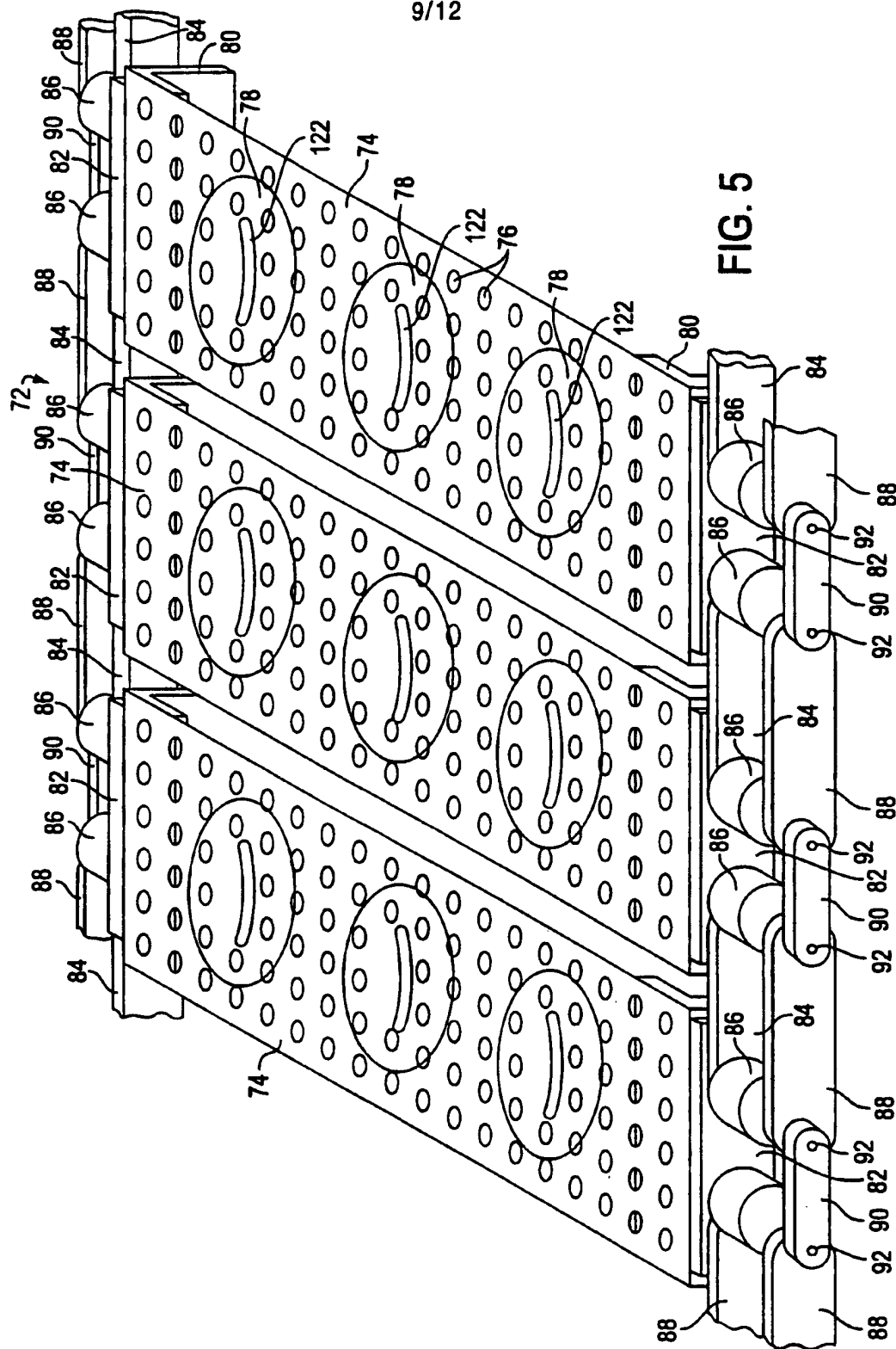


FIG. 5

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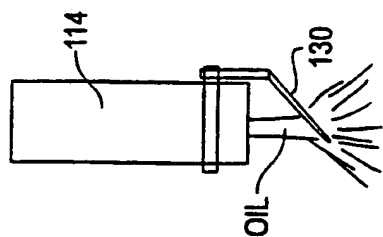


FIG. 8

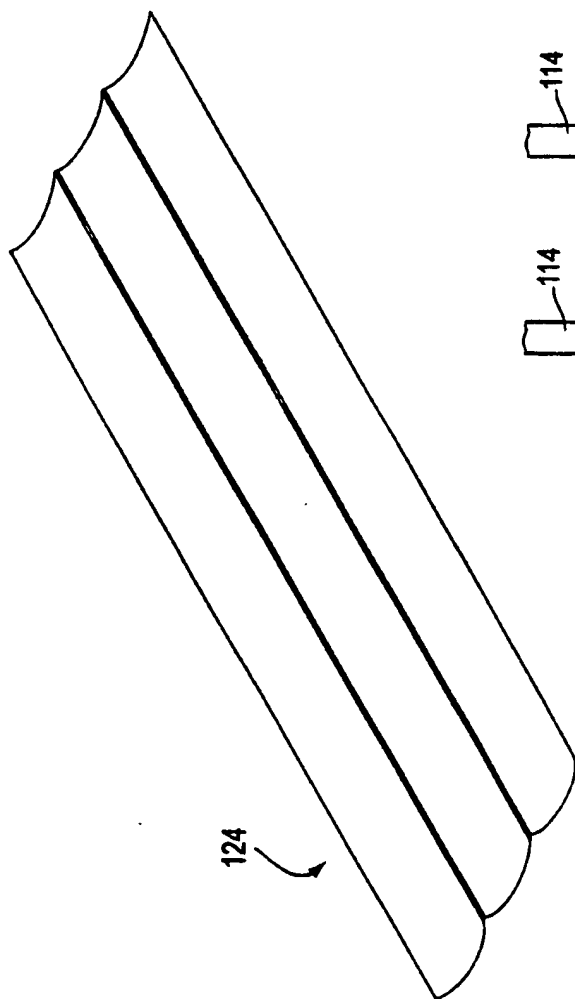


FIG. 6

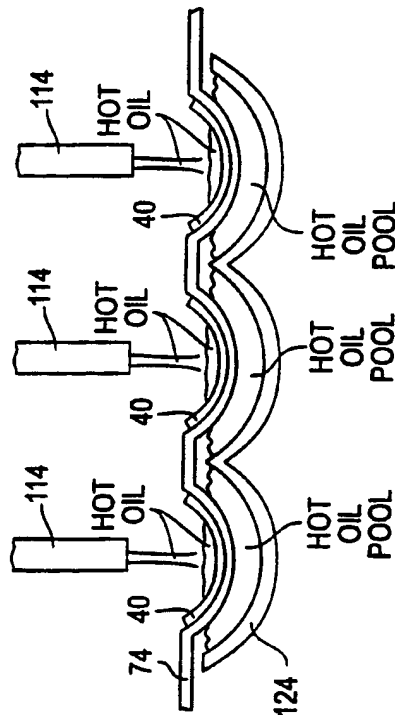


FIG. 7

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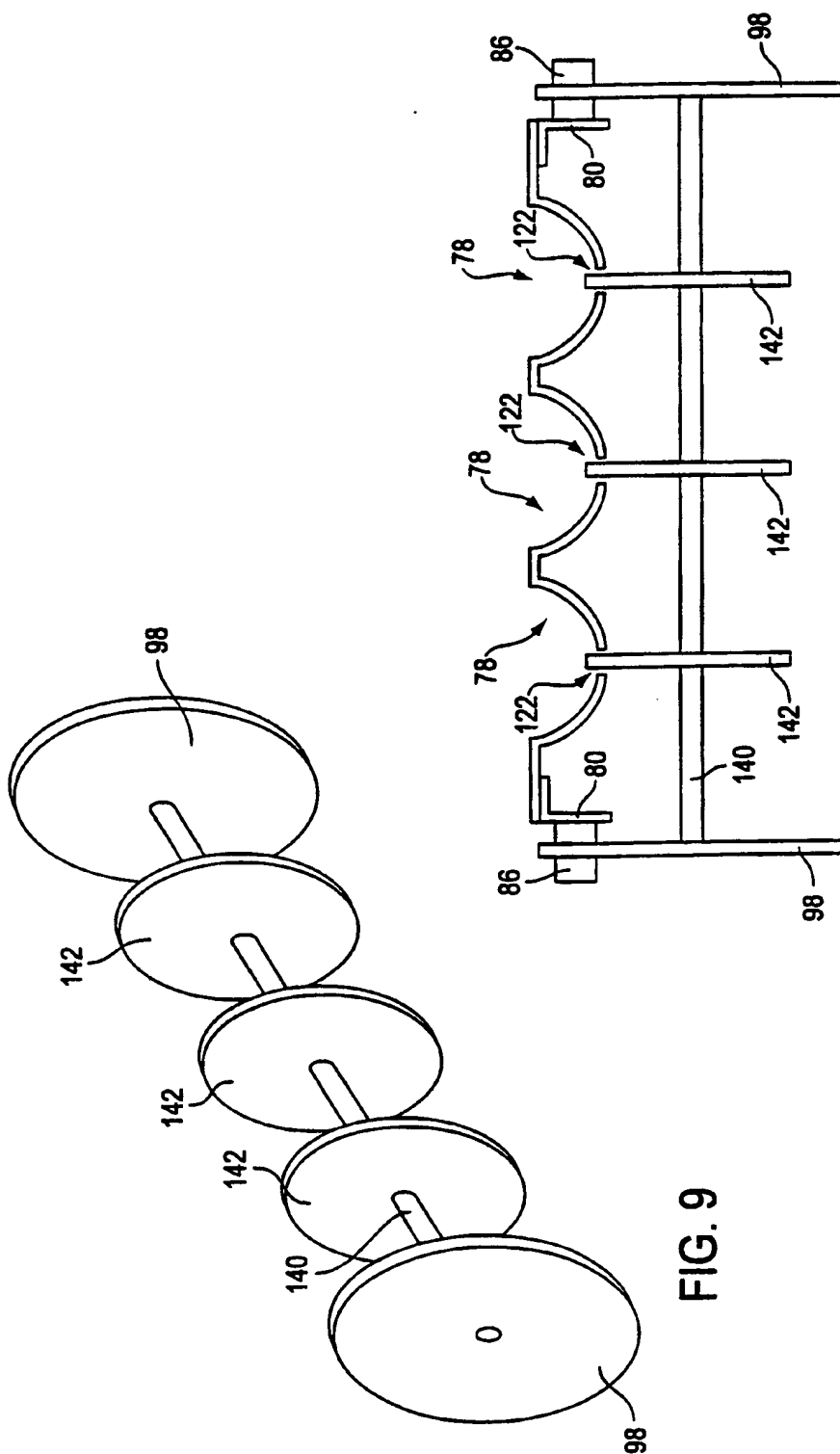
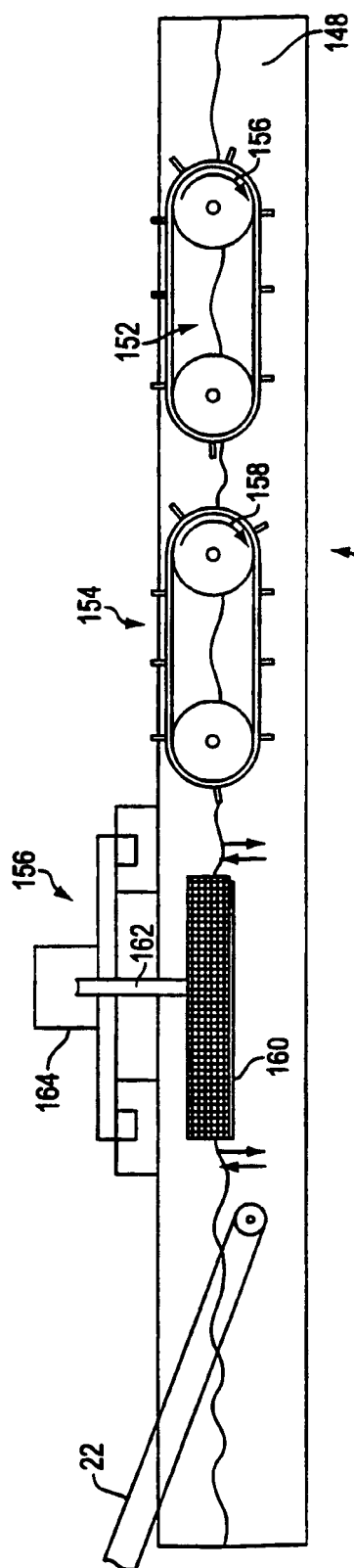


FIG. 9

FIG. 10

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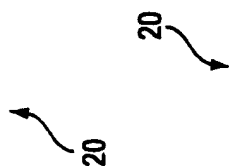


FIG. 11A

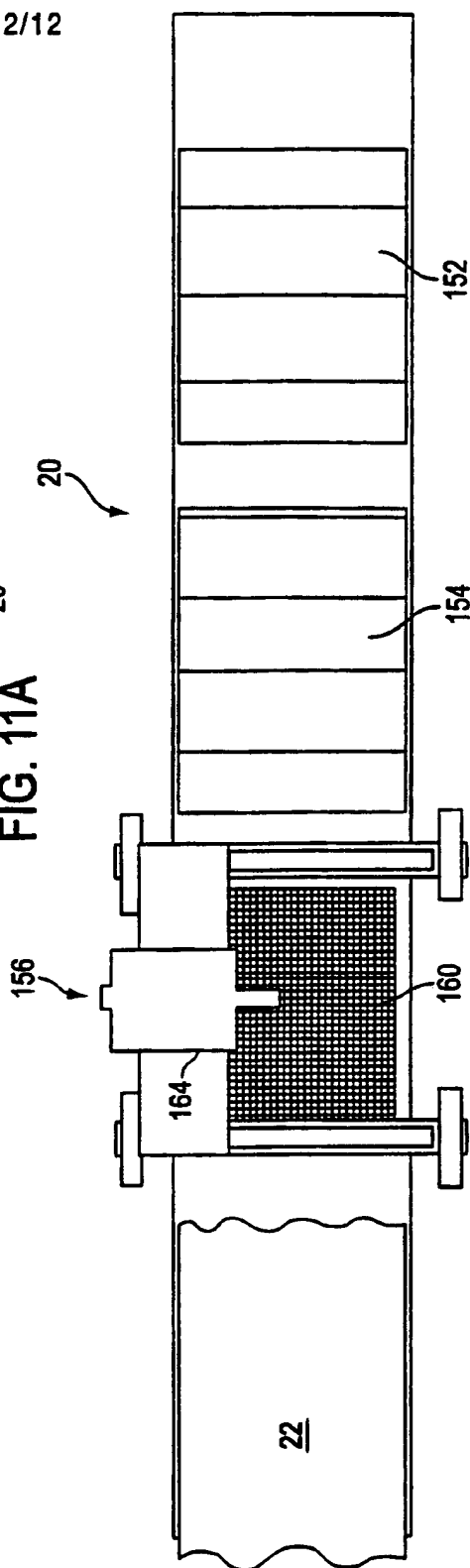


FIG. 11B

SUBSTITUTE SHEET (RULE 26)

INTERNATIONAL SEARCH REPORT

International Application No

PCT/US 99/16444

A. CLASSIFICATION OF SUBJECT MATTER

IPC 7 A23L1/01 A23L1/164 A23L1/217 A21B5/08 A47J37/12

According to International Patent Classification (IPC) or to both national classification and IPC

B. FIELDS SEARCHED

Minimum documentation searched (classification system followed by classification symbols)

IPC 7 A23L A21B A47J

Documentation searched other than minimum documentation to the extent that such documents are included in the fields searched

Electronic data base consulted during the international search (name of data base and, where practical, search terms used)

C. DOCUMENTS CONSIDERED TO BE RELEVANT

Category *	Citation of document, with indication, where appropriate, of the relevant passages	Relevant to claim No.
X	US 3 690 895 A (AMADON ROGER M ET AL) 12 September 1972 (1972-09-12) column 1, line 13 - line 20 column 2, line 10 - line 22 figures 1-7 ---	18
X	US 3 512 990 A (SLAYBAUGH LYLE) 19 May 1970 (1970-05-19) the whole document ---	18
X	US 4 650 687 A (WILLARD MILES J ET AL) 17 March 1987 (1987-03-17) column 3, line 60 - column 4, line 49 column 5, line 13 - line 24 column 12, line 25 - column 15, line 47 figure 1 --- -/-	18,19,23

☒ Further documents are listed in the continuation of box C.

☒ Patent family members are listed in annex.

* Special categories of cited documents :

- *A* document defining the general state of the art which is not considered to be of particular relevance
- *E* earlier document but published on or after the international filing date
- *L* document which may throw doubts on priority claim(s) or which is cited to establish the publication date of another citation or other special reason (as specified)
- *O* document referring to an oral disclosure, use, exhibition or other means
- *P* document published prior to the international filing date but later than the priority date claimed

- *T* later document published after the international filing date or priority date and not in conflict with the application but cited to understand the principle or theory underlying the invention
- *X* document of particular relevance; the claimed invention cannot be considered novel or cannot be considered to involve an inventive step when the document is taken alone
- *Y* document of particular relevance; the claimed invention cannot be considered to involve an inventive step when the document is combined with one or more other such documents, such combination being obvious to a person skilled in the art.
- *Z* document member of the same patent family

Date of the actual completion of the international search

25 October 1999

Date of mailing of the international search report

23. 11. 1999

Name and mailing address of the ISA

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Authorized officer

Vuillamy, V

INTERNATIONAL SEARCH REPORT

International Application No

PCT/US 99/16444

C.(Continuation) DOCUMENTS CONSIDERED TO BE RELEVANT

Category *	Citation of document, with indication, where appropriate, of the relevant passages	Relevant to claim No.
X	US 3 149 978 A (E.E.ANDERSON) 22 September 1964 (1964-09-22) figure 5 ---	23
X	US 3 132 949 A (M.N.CROWE) 12 May 1964 (1964-05-12) figure 5 ---	23
X	US 3 394 646 A (CUNNINGHAM FRED A ET AL) 30 July 1968 (1968-07-30) the whole document ---	18
A	US 3 520 248 A (MACKENDRICK ROBERT G) 14 July 1970 (1970-07-14) the whole document ---	
A	PATENT ABSTRACTS OF JAPAN vol. 006, no. 127 (C-113), 13 July 1982 (1982-07-13) & JP 57 054561 A (KOUFU TOYO KK), 1 April 1982 (1982-04-01) abstract ---	1,14,18
A	PATENT ABSTRACTS OF JAPAN vol. 015, no. 332 (C-0861), 23 August 1991 (1991-08-23) & JP 03 127941 A (KIMIO HAYASHI), 31 May 1991 (1991-05-31) abstract -----	1,14,18

INTERNATIONAL SEARCH REPORT

International application No.

PCT/US 99/ 16444

Box I Observations where certain claims were found unsearchable (Continuation of Item 1 of first sheet)

This International Search Report has not been established in respect of certain claims under Article 17(2)(a) for the following reasons:

1. ☐ Claims Nos.:
because they relate to subject matter not required to be searched by this Authority, namely:
2. ☐ Claims Nos.:
because they relate to parts of the International Application that do not comply with the prescribed requirements to such an extent that no meaningful International Search can be carried out, specifically:
3. ☐ Claims Nos.:
because they are dependent claims and are not drafted in accordance with the second and third sentences of Rule 6.4(a).

Box II Observations where unity of invention is lacking (Continuation of Item 2 of first sheet)

This International Searching Authority found multiple inventions in this international application, as follows:

see further information

1. ☐ As all required additional search fees were timely paid by the applicant, this International Search Report covers all searchable claims.
2. ☒ As all searchable claims could be searched without effort justifying an additional fee, this Authority did not invite payment of any additional fee.
3. ☐ As only some of the required additional search fees were timely paid by the applicant, this International Search Report covers only those claims for which fees were paid, specifically claims Nos.:
4. ☐ No required additional search fees were timely paid by the applicant. Consequently, this International Search Report is restricted to the invention first mentioned in the claims; it is covered by claims Nos.:

Remark on Protest

- ☐ The additional search fees were accompanied by the applicant's protest.
- ☐ No protest accompanied the payment of additional search fees.

Form PCT/ISA/210 (continuation of first sheet (1)) (July 1998)

FURTHER INFORMATION CONTINUED FROM PCT/ISA/ 210

This International Searching Authority found multiple (groups of) inventions in this international application, as follows:

1. Claims: 1-13, 25-42

Process and apparatus for making bowl-shaped snack food comprising using a mold and filling the bowl-shaped snack with hot oil

2. Claims: 14-17

Process for making bowl-shaped snack food with a mold, the dough being unrestrained in the mold

3. Claims: 18-22

Process for making bowl-shaped snack food by making dough preforms that are able to maintain their shape

4. Claims: 23-24

A method for removing cooked food products from a vat

INTERNATIONAL SEARCH REPORT

International Application No

PCT/US 99/16444

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JP 03127941 A	31-05-1991	NONE	

Form PCT/ISA/210 (patent family annex) (July 1992)

